

**What Is Claimed Is:**

1           1. A method of determining the status of a bi-directional virtual circuit in a first end  
2 system, wherein said bi-directional virtual circuit is provisioned between said first end system  
3 and another end system, said method comprising:

4           receiving in said first end system a plurality of loopback command packets from said  
5 another end system on said bi-directional virtual circuit;

6           sending from said first end system a plurality of loopback response packets to said  
7 another end system, wherein said another end system determines that said bi-directional  
8 virtual circuit is operational based on the reception of said plurality of said response packets;  
9 and

10          concluding in said first end system that said bi-directional virtual circuit is operational  
11 according to the determination of said another end system.

12           2. The method of claim 1, wherein said concluding comprises:

13          examining a receive frequency at which said plurality of loopback command packets  
14 are received; and

15          determining that said bi-directional virtual circuit is operational if said receive  
16 frequency does not change substantially.

17           3. The method of claim 2, wherein said bi-directional virtual circuit comprises a  
18 permanent bi-directional virtual circuit provisioned on an asynchronous transfer mode (ATM)  
19 backbone, and each of said plurality of loopback command packets and plurality of loopback  
20 response packets comprises a cell.

1           4. The method of claim 3, wherein said plurality of loopback command packets and  
2 said plurality of loopback response packets are generated consistent with ITU-T  
3 Recommendation I.610.

1           5. The method of claim 2, wherein said first end system continues to conclude that  
2 said bi-directional virtual circuit is operational if said receive frequency does not change  
3 substantially and does not send new loopback command packets to said another end system.

1           6. The method of claim 5, further comprising:  
2           sending another plurality of loopback command packets at a sending frequency; and  
3           comparing said sending frequency with said receive frequency, wherein said first end  
4 system determines not to send new loopback command packets based on said comparing.

1           7. The method of claim 6, wherein said first end system determines not to send new  
2 loopback command packets if said sending frequency is less than said receiving frequency.

1           8. The method of claim 6, wherein said first end system waits a random amount of  
2 time before stopping sending new loopback command packet if said sending frequency is at  
3 least approximately equal to said receive frequency.

1           9. The method of claim 1, wherein each of said first end system and said another end  
2 system comprises an edge router.

1           10. A first end system determining the status of a bi-directional virtual circuit, wherein  
2           said bi-directional virtual circuit is provisioned between said first end system and another end  
3           system on a network backbone, said first end system comprising:

4           an interface coupled to said network backbone, said interface receiving a plurality of  
5           loopback command packets from said another end system on said bi-directional virtual circuit;

6           a memory storing information indicating whether said bi-directional virtual circuit is  
7           operational; and

8           a processor sending a plurality of loopback response packets to said another end  
9           system in response to receiving said plurality of loopback command packets, wherein said  
10          another end system determines that said bi-directional virtual circuit is operational based on  
11          the reception of said plurality of said response packets, said processor storing data in said  
12          memory indicating that said bi-directional virtual circuit is operational if said another end  
13          system determines that said bi-directional virtual circuit is operational.

1           11. The first end system of claim 10, wherein said processor examines a receive  
2           frequency at which said plurality of loopback command packets are received and determines  
3           that said bi-directional virtual circuit is operational if said receive frequency does not change  
4           substantially.

1           12. The first end system of claim 11, wherein said bi-directional virtual circuit  
2           comprises a permanent bi-directional virtual circuit provisioned on an asynchronous transfer  
3           mode (ATM) backbone, and each of said plurality of loopback command packets and plurality

4 of loopback response packets comprises a cell.

1 13. The first end system of claim 12, wherein said plurality of loopback command  
2 packets and said plurality of loopback response packets are generated consistent with ITU-T  
3 Recommendation I.610..

1 14. The first end system of claim 11, wherein said first end system continues to  
2 conclude that said bi-directional virtual circuit is operational if said receive frequency does  
3 not change substantially and does not send new loopback command packets to said another  
4 end system.

1 15. The first end system of claim 14, further comprising:  
2 sending another plurality of loopback command packets at a sending frequency; and  
3 comparing said sending frequency with said receive frequency, wherein said first end  
4 system determines not to send new loopback command packets based on said comparing.

1 16. The first end system of claim 15, wherein said memory continues to indicate that  
2 said bi-directional virtual circuit is operational if said sending frequency is less than said  
3 receiving frequency.

1 17. The first end system of claim 15, wherein said first end system waits a random  
2 amount of time before stopping sending new loopback command packet if said sending  
3 frequency is at least approximately equal to said receive frequency.

1 18. The first end system of claim 10, wherein each of said first end system and said  
2 another end system comprises an edge router.

1 19. The first end system of claim 10, wherein said memory stores a virtual circuit (VC)  
2 table, wherein said VC table stores data indicating whether said bi-directional virtual circuit  
3 is operational.

1 20. The first end system of claim 10, wherein data packets are transmitted on said bi-  
2 directional virtual circuit only if said memory indicates that said bi-directional virtual circuit  
3 is operational.

1 21. A first end system determining the status of a bi-directional virtual circuit, wherein  
2 said bi-directional virtual circuit is provisioned between said first end system and another end  
3 system on a network backbone, said first end system comprising:

4 means for receiving a plurality of loopback command packets from said another end  
5 system on said bi-directional virtual circuit;

6 means for sending a plurality of loopback response packets to said another end system,  
7 wherein said another end system determines that said bi-directional virtual circuit is  
8 operational based on the reception of said plurality of said response packets;

9 means for storing data indicating whether said bi-directional virtual circuit is  
10 operational or not; and

11 means for concluding that said bi-directional virtual circuit is operational according

12 to the determination of said another end system, wherein said means for concluding causes  
13 said means for storing to store data to indicate that said bi-directional virtual circuit is  
14 operational.

1 22. The first end system of claim 21, wherein said means for concluding determines  
2 a receive frequency at which said plurality of loopback command packets are received and  
3 determines that said bi-directional virtual circuit is operational if said receive frequency does  
4 not change substantially.

1 23. The first end system of claim 22, wherein said bi-directional virtual circuit  
2 comprises a permanent virtual circuit provisioned on an asynchronous transfer mode (ATM)  
3 backbone, and each of said plurality of loopback command packets and plurality of loopback  
4 response packets comprises a cell.

1 24. The first end system of claim 23, wherein said plurality of loopback command  
2 packets and said plurality of loopback response packets are generated consistent with ITU-T  
3 Recommendation I.610.

1 25. A computer readable medium carrying one or more sequences of instructions for  
2 causing a first end system to determine the status of a bi-directional virtual circuit, wherein  
3 said bi-directional virtual circuit is provisioned between said first end system and another end  
4 system, wherein execution of said one or more sequences of instructions by one or more  
5 processors contained in said gateway device causes said one or more processors to perform

6 the actions of:  
7 receiving a plurality of loopback command packets from said another end system on  
8 said bi-directional virtual circuit;  
9 sending a plurality of loopback response packets to said another end system, wherein  
10 said another end system determines that said bi-directional virtual circuit is operational based  
11 on the reception of said plurality of said response packets; and  
12 concluding that said bi-directional virtual circuit is operational according to the  
13 determination of said another end system.

26. The computer readable medium of claim 25, wherein said concluding comprises:  
2 examining a receive frequency at which said plurality of loopback command packets  
3 are received; and  
4 determining that said bi-directional virtual circuit is operational if said receive  
5 frequency does not change substantially.

1 27. The computer readable medium of claim 26, wherein said bi-directional virtual  
2 circuit comprises a permanent virtual circuit provisioned on an asynchronous transfer mode  
3 (ATM) backbone, and each of said plurality of loopback command packets and plurality of  
4 loopback response packets comprises a cell.

1 28. The computer readable medium of claim 27, wherein said plurality of loopback  
2 command packets and said plurality of loopback response packets are generated consistent  
3 with ITU-T Recommendation I.610.

1           29. The computer readable medium of claim 26, wherein said first end system  
2 continues to conclude that said bi-directional virtual circuit is operational if said receive  
3 frequency does not change substantially and does not send new loopback command packets  
4 to said another end system.

1           30. The computer readable medium of claim 29, further comprising:  
2 sending another plurality of loopback command packets at a sending frequency; and  
3 comparing said sending frequency with said receive frequency, wherein said first end  
4 system determines not to send new loopback command packets based on said comparing.

1           31. The computer readable medium of claim 30, wherein said first end system  
2 determines not to send new loopback command packets if said sending frequency is less than  
3 said receiving frequency.

1           32. The computer readable medium of claim 30, wherein said first end system waits  
2 a random amount of time before stopping sending new loopback command packet if said  
3 sending frequency is at least approximately equal to said receive frequency.